last year; and the donations 33*l.* 2*s.*, as against 18*l.* There had been several large legacies realised, amongst them one of 4050*l.* from Mrs. George Oakes.

MANCHESTER.—We understand that a sum of 1500*l.* has been offered by a benefactor to the Council of Owens College for five fellowships of 100*l.* a year, each renewable for a second or third year, the conditions being that they shall be awarded on evidence given by the candidates of their past work in literature or science, and on their satisfying the electors as to their subsequent devotion to original work. The scheme is as yet only under consideration. We likewise understand that Mr. Waterhouse is preparing plans for completing a portion of the buildings required for Owens College, including museums for natural history, geology, and mineralogy, and for the lecture-rooms and laboratories required for the professors of the above subjects.

On Saturday next (May 21) Prof. Boyd Dawkins, F.R.S., will begin the seventh series of Field Lectures in Geology, at Miller's Dale Station, Derbyshire. That and the two following Saturdays will be devoted to the examination of the Carboniferous rocks of the Pennine Chain. On Saturday, June 9, the class will visit the British Museum (natural history) under the guidance of Dr. Woodward, F.R.S., for the study of the mammalia associated with Pleistocene Man. On June 10 the brickfields at Crayford and Erith, in Kent, will be visited under the guidance of Mr. F. C. Spurrell; and on the 11th the subject of the Antiquity of Man will be finished by an examination of the collections of prehistoric archæology in the British Museum (Bloomsbury).

THE Queen has directed letters patent to be passed under the Great Seal granting and declaring that the degrees of Bachelor and Master of Arts and Bachelor and Doctor of Medicine, of Laws, of Science, and of Music, granted or conferred by the University of Adelaide, South Australia, on any person, male or female, shall be recognised as academic distinctions and rewards of merit, and be entitled to rank, precedence, and consideration in the United Kingdom and in the colonies and possessions of the Crown throughout the world, as fully as if the said degrees had been granted by any university of the United Kingdom.

SCIENTIFIC SERIALS

Journal of the Royal Microscopical Society for April, 1881, vol. i. ser. ii. part 2, contains—Prof. P. Martin Duncan, on a Radiolarian and some Microspongidæ from considerable depths in the Atlantic Ocean (plate 3).—Dr. Lionel S. Beale, the President's address.—Prof. E. Abbe, on the conditions of orthoscopic and pseudoscopic effects on the binocular microscope.—A. D. Michael, on a species of Acarus believed to be unrecorded (plate 4).—Prof. E. Abbe, on the estimation of aperture in the microscope. The summary of current researches, pp. 217–364.—Proceedings of the Society. (In the summary of current researches appears a memoir by Mr. Crisp, "On Aperture, Microscopical Vision, and the Value of Wide-Angled Immersion Objectives," in which the whole subject is very exhaustively and clearly put.)

Annalen der Physik und Chemie, No. 4.—Experimental investigation of the connection between refraction and absorption of light, by E. Ketteler.—On the ratio of intensity of the two sodium lines, by W. Dietrich.—On the condensation of gases on surfaces in their relation to pressure and temperature, by H. Kayser.—Influence of pressure on the surface-tension of liquids, by A. Kundt.—Variations of the vapour-density of some esters with pressure and temperature, by P. Schoop.—On differences of tension between liquids touching each other, with reference to concentration, by E. Kittler.—On electric ring-figures and their alteration of form by the magnet, by E. Reitlinger and F. Wächter.—On the divergence of Ampère's theory of magnetism from the theory of electromagnetic forces, by J. Stefan.—On some remarks of Herr C. Neumann on electrodynamics, by R. Clausius.—The law of Clausius and the motion of the earth in space, by E. Budde.—On the extent of the electric expansion in glass and caoutchouc, by Dr. J. Korteweg and V. A. Julius.—The glass plate battery, by Th. Erhard.—Some remarkable properties of flames, by W. Holtz.

American Journal of Science, April.—Monograph by Prof. Marsh on the Odontornithes, or toothed birds of North America, by G. B. Grinnell.—On some elements in orographic displacement, by W. J. McGee.—On the indices of refraction of certain compound ethers, by J. H. Long.—On the Whitfield County, Georgia, meteoric iron, by W. E. Hidden.—The basin of the Gulf of Mexico, by J. E. Hilgard.—On the geology of Florida, by E. A. Smith.—The magnetic survey of Missouri, by F. E. Nipher.—American sulpho-selenides of mercury, by G. J. Brush.—Analysis of Onofrite from Utah, by W. J. Comstock.—Effect of great cold on magnetism, by J. Trowbridge.—Channel fillings in Upper Devonian shales, by H. S. Williams.—A new order of Jurassic reptiles (Cæluria), by O. C. Marsh.—Discovery of a fossil bird in the Jurassic of Wyoming, by the same.—American pterodactyls, by the same.

Journal of the Franklin Institute, March.—Experiments with the Perkins machinery of the *Anthracite*, by Mr. Isherwood.—The wearing power of steel rails in relation to their chemical composition and physical properties, by Dr. Dudley.—Note on steam cylinders, by Prof. Marks.—Novel mode of originating an index wheel, by Dr. Grimshaw.—The polarisation of sound and the nature of vibrations in extended media, by Prof. Robinson.—Gyroscope model for class-illustration, by Dr. Rand.

Reale Istituto Lombardo di Scienze e Lettere. Rendiconti, vol. xiv. fasc. vii.—Grafts of the vine, by Count Trevisan.—On the determination of maximum moments, &c. (continued), by Prof. Clericetti.—On two rare helminths of reptiles, by Prof. Pavesi.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, April 28.—"The influence of Stress and Strain on the Action of Physical Forces." By Herbert Tomlinson, B.A. Communicated by Prof. W. Grylls Adams, M.A., F.R.S. Part I.—Elasticity. "Young's Modulus."

The values of "Young's modulus" were determined for several metals by a method devised by Sir W. Thomson.

A large number of experiments with different loads were made, and after a great many unsuccessful attempts to account for certain discrepancies which could not be explained away as errors of observation, the following facts were elicited:—

1. After a wire has suffered permanent extension, the temporary elongation which can be produced by any load becomes less as the interval between the period of permanent extension and that of applying the load becomes greater.

2. This increase of elasticity is greater in proportion for large loads than for small ones.

3. The increase of elasticity takes place whether the wire be allowed to remain loaded or unloaded between the period of permanent extension and that of the testing for the elasticity.

4. The *rate of increase* of elasticity varies considerably with different metals; with some the maximum elasticity is apparently attained in a few minutes, and with others not till some days have elapsed, iron and steel being in this last respect very remarkable.

5. The elasticity can also be increased by heavily loading and unloading several times, the rate of increase diminishing with each loading and unloading.

6. A departure from "Hooke's law" more or less decided always attends recent permanent extension, even when the weights employed to test the elasticity do not exceed one-tenth of the breaking weight.

7. This departure is diminished very noticeably in the case of iron, and much less so in the case of other metals, by allowing the wire to rest for some time either loaded or unloaded; it is also diminished by repeated loading and unloading.

The effect of permanent extension on the value of "Young's modulus" was tried according to the direct method for iron and copper, and indirectly for most of the metals.

From both the direct and indirect methods results were obtained which showed:—

1. That, in all metals, provided the wire has not been kept heavily loaded for some time before testing, permanent extension produces decrease of elasticity, if the strain be not carried beyond a certain limit.

2. That, if the extension be carried beyond the above-mentioned limit, further permanent increase of length causes increase of elasticity.

3. That, in the case of iron, heavy loading for some time so increases the elasticity that, even when the extension would have caused diminution of elasticity without such continued loading, the latter will, if sufficient time be allowed, change this diminution into an increase; in the case of copper this is not so.

The effect of suddenly chilling steel heated to a high tempera-

ture was found to be similar to that of excessive permanent extension of iron.

Several experiments were made to test the effect of permanent torsion and permanent extension on the modulus of rigidity.

From these experiments it was concluded :—

1. That the loss of rigidity produced by twisting or stretching a wire beyond the limits of elasticity is partly diminished by rest.

2. That the loss is more sensible with large arcs of vibration than with small ones.

3. That the influence of rest is more apparent in the case of large vibrations than in that of small ones.

4. That continual vibrating through large arcs has a similar effect on the rigidity to that produced on the longitudinal elasticity by heavily loading and unloading. And—

5. That in the case of hard steel the effect of vibrating through a large arc for several minutes makes temporarily the rigidity as determined from such vibrations greater than that determined from smaller vibrations.

The influence of an electric current and of magnetism on the torsional rigidity of metals was also investigated, and the following results arrived at :—

1. The torsional rigidity of copper and iron is temporarily decreased by the passage of a powerful electric current, but is very little, if at all appreciably, altered by currents of moderate intensity.

2. The torsional rigidity of iron is temporarily diminished to a small but perceptible extent by a high magnetising force.

3. The effects mentioned in 1 and 2 are independent of any changes produced by the current in the temperature of the wire.

Finally, certain critical points are alluded to, there being at least two such for each metal, at which sudden changes take place in the ratio of the permanent extension produced by any load and the load itself.

May 5.—"On the Structure and Development of the Skull in Sturgeons (*Acipenser ruthenus* and *A. sturio*)," by W. K. Parker, F.R.S.

I must refer the reader to Prof. Salensky's[1] invaluable work on the development of the sterlet (Kasan, 1878), unfortunately published in *Russian*, and to the second volume of Mr. Balfour's new work, for an account of the earliest stages of the *Acipenserine* embryo.

Even in larvæ one-third of an inch in length, the cartilage was becoming consolidated, and I was able to work out, by sections and dissections, the structure of the cranium and visceral arches; the one specimen which was seven-twelfths of an inch in length, and which was made into a large number of extremely thin sections, left nothing to be desired.

The development of the skull of the sturgeon is very similar to what we find in the sharks and skates ("Selachians"), but the suspension of both the mandibular and the hyoid arches by one pier, derived from the hyoid (the *hyostylic* skull), which is seen in the Selachians on one hand and in the Holostean Ganoids and Teleosteans on the other, attains its fullest development in the "Acipenseridæ," or Chondrosteous Ganoids; for in them the "symplectic" is a separate cartilage, and not a mere osseous centre as in *Lepidosteus* and the Teleostei.

Here I find a very noticeable fact, namely, that whilst in the salmon the metamorphosis of the simple primary arches of the face can be followed step by step, in the sturgeon the peculiar modification of the arches shows itself *during chondrification;* the hyoid arch, from the first, is inordinately large.

Notwithstanding the huge size of the sub-divided hyoid pier, its head only articulates in the larva with the auditory capsule; later on the basal cartilage reaches it, as in the Selachians.

But the arches that retain their normal size lend no colour to the theory that the visceral arches are related by their dorsal ends to the paired cartilages that invest the notochord, a state of things like that seen in the ribs and in the superficial cartilaginous hoops that surround the huge pharynx of the lamprey.

Mr. Balfour has demonstratively shown that in the branchial region, when the pleuro-peritoneal cavity has been sub-divided by the hypoblastic outgrowths of the pharynx, the aortic arches lie *inside* the small temporary "head cavities," or remnants of the once continuous sub-division of the body wall into an inner layer, the "splanchno-pleure," and an outer layer, the "somato-pleure."

But the aortic arches mount up, on each side, *outside* the proper branchial arches, which become grooved to receive them; these arches must therefore be considered as developments of the temporarily separate "splanchno-pleure"; they cannot be classed with the *costal* arches, which are developed in the permanently distinct "somato-pleure."

My dissections and sections, both of this type and of the Selachians, show, without leaving room for doubt, that all the visceral, or, properly speaking, *branchial* arches, mandibular, hyoid, and post-hyoid (branchial proper) are developed in the outer walls of the large respiratory pharynx, quite independently of the base of the skull and the fore part of the spinal column.

I have at last ceased to contend for true branchial or visceral arches in front of the mouth, and also to look upon the mouth and the openings around or in front of it as more than mere *involutions* of the epiblast; the *first cleft* is that between the mandible and the hyoid arch, the first arch is the mandibular.

With regard to the skull, it is now very evident that the "trabeculæ cranii," even in their furthest growth forwards from the end of the cephalic notochord, are merely *foregrowths* from the moieties of the investing mass (the parachordals), the true axis of the cranial skeleton ending under the fold of the mid-brain. The "cornua trabeculæ," and the "intertrabecular" part or tract, are *fresh shoots*, so to speak of cartilage that are specially developed to finish the cranial box and the internasal framework. I fear that my long-cherished *pre-oral visceral arches* will now have to go down and take their place among these *secondary* or *adaptive* growths.

I may remark, in concluding this very imperfect "abstract," that the sturgeon is a very important type for the morphologist to get clear light upon.

In the Selachians the huge pterygoid foregrowth of the mandibular arch aborts the apex of its pier, whose *function* is supplied by the hyo-mandibular; fragments only are developed in its upper part.

In the sharks from *one* to *three* mere "rays" are developed in front of the small upper remnant of the first cleft ("spiracle"); in skates there is, as a rule, a small separate piece, the true apex of the arch, its "pedicle." In one kind, however, the torpedo, four such fragments appear on each side, as shown by Gegenbaur. In the sturgeon there is a most remarkable plate in the common metapterygoid region, its form is rhomboidal; it is composed of a number of well-compacted pieces of cartilage, a middle series of *azygous* plates, and a somewhat irregular arrangement of plates right and left of these. This remarkable structure only exists in the Acipenseroids; it is not found in *Polyodon*.

In the Selachians the "placoid" plates or spines are not brought under the influence of the chondrocranium, which has neither parosteal plates applied as splints to it nor ectosteal plates grafted upon it.

In *Acipenser* there are both parostoses applied to the oral apparatus, and ectosteal centres in the post-mandibular arches; morever, along the side of the skull, in old individuals, plates of bone appear as splints or parostoses, that are manifestly the forerunners of the deeper plates that in the higher Ganoids and the Teleostei form the proper ectosteal bony centres of the more or less ossified cranial box.

The Ganoid scutes of the sturgeon are so far dominated by the huge chondrocranium, that *by courtesy* they may be called frontal, parietal, opercular, and the like; of course such scutes are not the accurate homologues of the bones so named in the Teleostei, which at the most can only correspond to the inner layer of the scute of such a fish as the sturgeon.

The sturgeons as a group cannot be said to lie directly between any one family of the Selachians and any one family of the Bony Ganoids, yet on the whole that is their position; the Bony Ganoids on the whole approach the Teleostei, especially such forms as *Lepidosteus* and *Amia*, which have lost their "spiracle," and in other things are less than typical, as Ganoids.

Larval sturgeons are, in appearance, miniature sharks; for a few weeks they have a similar mouth, and their lips and throat are beset with true teeth that are moulted before calcification has fairly set in. Their first gills are very long and exposed, but not nearly so long, or for such a time uncovered, as in the embryos of sharks and skates.

Mathematical Society, May 12.—S. Roberts, F.R.S., president, in the chair.—Prof. C. Niven, F.R.S., was admitted into the Society, and the following were elected members :—I. Rosenthal, B.A. Dublin, C. A. van Velzer, F. Franklin, Ph.D, and Miss Christine Ladd, the last three of the Johns Hopkins

[1] My smallest specimens were the gift of Prof. W. Salensky, the larger of the late Mr. William Lloyd.

University, Baltimore.—The following communications were made:—On Ptolemy's theorem, by Mr. Merrifield, F.R.S.—The summation of certain hypergeometric series, by the Rev. T. R. Terry.—Quaternion proof of Mr. S. Roberts's theorem of four co-intersecting spheres, by Mr. J. J. Walker.—Some solutions of the "15-girl" problem, by Mr. Carpmael.—Note on the co-ordinates of a tangent line to the curve of intersection of two quadrics, by Mr. W. R. W. Roberts.—Shorter communications were made by the President, Prof. Cayley, F.R.S., Mr. Hart, and Mr. J. J. Walker.

Entomological Society, May 4.—H. T. Stainton, F.R.S., president, in the chair.—Two new Members and one Subscriber were elected.—Mr. R. Trimen made some observations on the sexes of *Pieris saba*, *Diadema mima*, and *Papilio cenea*, and exhibited specimens in illustration. He also remarked on *Tinea gigantella* having been bred from the hoof of a dead horse, and on the uncertainty which still exists as to whether the larva of this species ever feeds on living horn or not.—The Secretary read a letter from the Colonial Office respecting the occurrence of *Phylloxera vastatrix* on vines in Victoria.—Mr. A. G. Butler communicated "Descriptions of New Genera and Species of Heterocarous *Lepidoptera* from Japan—*Noctuites*."

PARIS

Academy of Sciences, May 9.—M. Wurtz in the chair.—The following papers were read:—Reply to some criticisms of the note of February 21, on the parallax of the sun, by M. Faye. He invites his English critics to correct his ten numbers according to their best information, and expects they will reach nearly the same result.—On nitrate of diazobenzol, by MM. Berthelot and Vieille. This solid crystalline body ($C_{12}H_4N_2NO_6H$) detonates with extreme violence when heated above 90° (and is thus much more sensitive to heat than fulminate of mercury). It also detonates when struck with a hammer or rubbed. It is now much used in making colouring matters.—On a new derivative of nicotine obtained by the action of selenium on this substance, by MM. Cahours and Étard. The collidine obtained is one of the propylpyridines corresponding to the isomeric position, still unknown, of nicotianic acid. Theory anticipates six collidines of this species. Selenium is found to be capable of removing nitrogen from an organic substance.—On the divisors of functions of periods of primitive roots of unity, by Prof. Sylvester.—On the densities of liquefied oxygen, hydrogen, and nitrogen in presence of a liquid without chemical action on these simple substances, by MM. Cailletet and Hautefeuille. The mixture was chiefly with carbonic acid. The density varied considerably with temperature and pressure. The coefficients of dilatation are so little different that the densities must be sensibly in the same ratio at 0° and at − 23°. The atomic volumes calculated are 17 for O, 30·3 for H, and 31·8 for N (dividing each of the atomic weights by the density at − 23°, viz. O, 0·89, H, 0·033, and N, 0·44). Gaseous O, H, and N diverge very unequally from Mariotte's law, at the pressures employed (275 and 300 atm.), and there is not then a simple relation between the atomic weight and the density; but on change of state by lowering of temperature in presence of a gas easily liquefiable, the atomic volume is found to reveal a positive relation between density and equivalent weight.—M. de Gasparin was elected Correspondent in Rural Economy, in room of the late M. Kuhlmann.—On displacement of a figure of invariable form in its plane, by M. Dewulf.—On the work-product of secondary batteries, by M. Regnier.—M. Mascart stated that Admiral Cloué, Minister of the Marine, would probably organise an expedition to islands near Cape Horn, taking part in the international scheme of simultaneous observations on terrestrial magnetism, &c.—On seeds of two species of Chinese vines discovered in 1872 by Abbé David in the province of Chen-si, by M. Du Caillaud.—M Vinot submitted a telescope made on a suggestion of M. Caussin. The image formed by one telescope is looked at with another of the same or different power.—Observations of Saturn's satellites at Toulouse in 1879 and 1880, by M. Baillaud.—Observations, elements, and ephemerides of the comet *a* 1881 (discovered by Mr. Lewis Swift on April 31), by M. Bigourdan.—On a system of differential equations, by M. Halphen.—On trilinear forms, by M. le Paige.—On some actinometric measurements made in the Alps in 1880, by M. Puiseux. The total radiation (that diffused by ground and sky as well as that direct from the sun) was found to be increased 0·10 at an altitude of 800 m. and 0·21 at 2100 m. At greater heights (3380 and 3251 m) the numbers were much higher, but less easy of interpretation, because of snow and mist; the reduced figures were 1·25 and 1·24 (showing good agreement with the others). Phanerogamic plants are found up to 3900 m., and must accomplish all their phases in the three summer months at a temperature below that of a polar summer. Doubtless the intensity of radiation compensates.—Action of light on phosphorescent substances, by M. Clémandot. He notes the confirmation, by M. Yung of Geneva, of his views that the phenomenon is physical, and the vibratory influence strongest in the blue ray. M. Becquerel called attention to his own researches thirty years ago.—Action of light on bromide of silver, by M. Noel. *Ceteris paribus*, silver bromide retains longer the molecular modification impressed on it by the chemical spectrum, the greater its sensibility, and when this first modification disappears it seems to have recovered its initial sensibility.—Action of carbonic acid on baryta and strontium, by M. Raoult.—On the products of action of perchloride of phosphorus on acroleine, by M. van Romburgh.—On the nature of the troubles produced by cortical lesions of the brain, by M. Couty. He rejects the theory of localisations, both on anatomical and physiological grounds.—On the poisonous action of the juice of manioc, by M. de Lacerda. It is not great, and it seems to affect the central nervous system.—On the *rôle* of marine currents in geographical distribution of amphibian mammalia, particularly Otaria, by M. Trouessart. These animals seem to have radiated from Antarctic regions. Their course to the North Pacific, &c., corresponds remarkably with that of certain currents.—Movements of juices and various plant-organs referred to a single cause; variations of hydrostatic tension, by M. Barthélemy.

VIENNA

Imperial Academy of Sciences, May 12.—V. Burg in the chair.—The following papers were read:—C. Claus, on tomora and tomorella.—Prof. L. Ditscheiner, on searching for spots of interruption at insufficiently insulated circuits.—E. Sathey, on the phenomena of exsiccation and imbibition on the involucra of Cymareæ.—Dr. R. Maly, on yolk-pigments.—E. Weiss, on the comet discovered by Lewis Swift (Rochester, U.S.) on May 2, &c.—E. Weiss, on a new method of computation of the apparent anomaly in orbits of great excentricity.—Dr. Zd. Skraup, on cinchonidine and homocinchonidine.

Imperial Institute of Geology, May 3.—The following papers were read:—Prof. Cornel. Doelter, on the geological state of the Cape Verde Isles.—M. Vacek, exhibition of the geological map of Trieste.—Dr. L. Szaynocha, on the occurrence of petroleum at Sloboda Rungurska.—Dr. E. Hussak, on the inclusion of resinous matters in the pycrite porphyry of Steyrdorf.

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